

Open Architecture Overview



Purpose of Brief



- ◆ **Explain Why New Approaches to Implementation of Warfighting Capabilities are Necessary**
- ◆ **Define OA Concepts as Applicable to Integrated Warfighting Systems**
- ◆ **Describe the Approach Being Used to Create and Deploy OA Systems**

Why OA?



- ◆ Enables Required Combat Capability

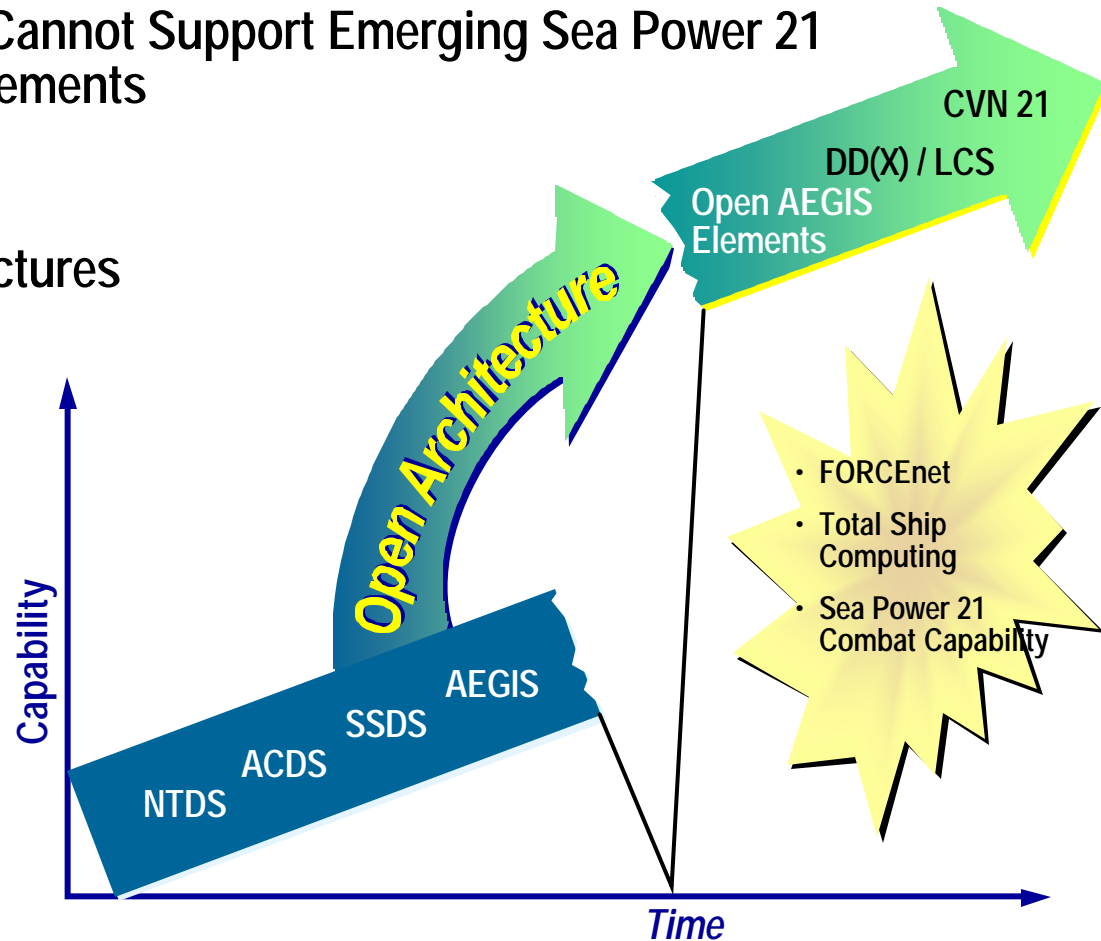
- Current Computing Systems Cannot Support Emerging Sea Power 21 Warfighting Capability Requirements

- ◆ Affordability

- In-service Computing Architectures are Unaffordable
- Each Ship Class Addresses Common Problems Uniquely
- Software and Hardware Changes Are Interdependent

- ◆ Joint Interoperability

- In-service Architectures can not Support Forcenet Implementation

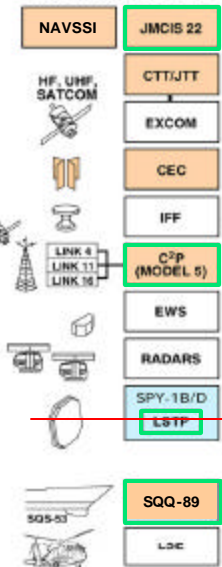


Key to Affordable 21st Century Joint Combat Capability

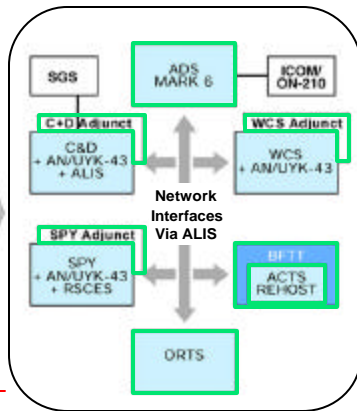
Computing Environment of Today's Ships



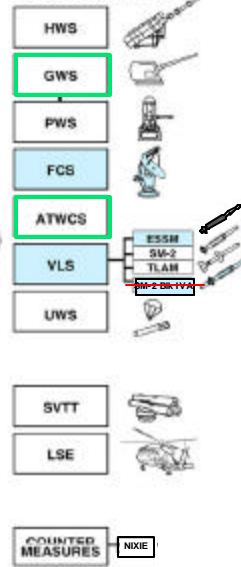
Sensors and Comms Incoming Interface



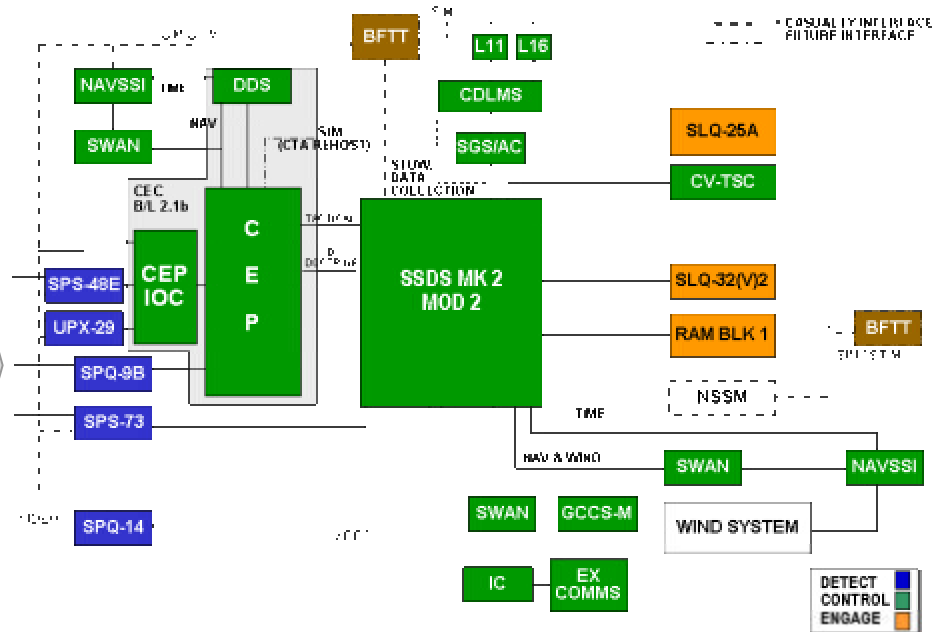
SPY, C&D, WCS, ORTS, ACTS Mission Control Elements



Weapon and CM Outgoing Interface



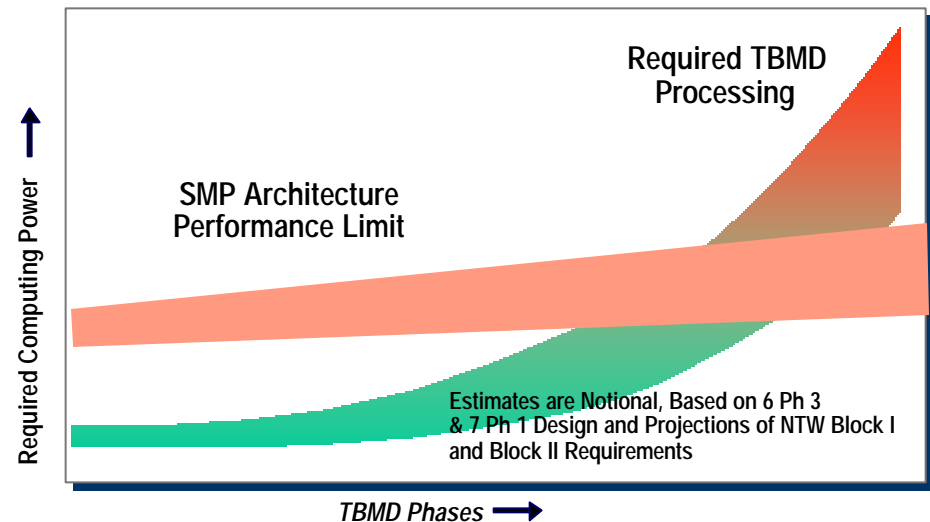
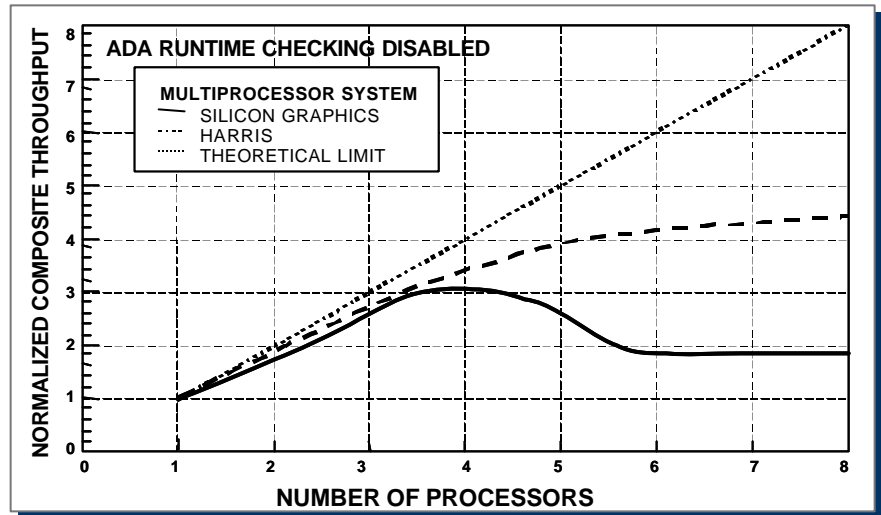
AWS Element Changed
ACS Element Changed
COTS





Increased Warfighting Capability

- ◆ Current Aegis Architecture Cannot Meet Processing Needed to Support TBMD Engagement
- ◆ OA Computing Plant Scalable to Meet Increased Processing Demand



OA Enables "aND Ship" Capability

OA... The Way to a Solution



Surface Combatant Ship System



Common
Computing
Environment

Common Surface
Combatant Ship
Functions

Surface
Combatant Ship
Unique Functions

SCS System
Unique
& Common
Applications
& Interfaces

Aircraft System



Common
Computing
Environment

Common Aircraft
Functions

Aircraft Unique
Functions

ACFT System
Unique
& Common
Applications
& Interfaces

CVN Ship System

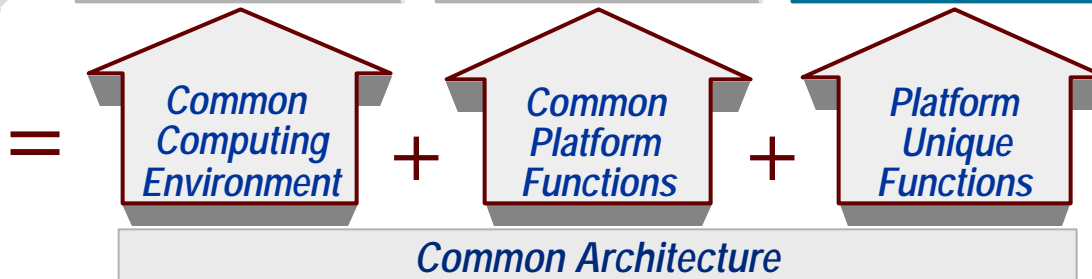


Common
Computing
Environment

Common CVN
Functions

CVN Unique
Functions

CV System
Unique
& Common
Applications
& Interfaces



What is OA?



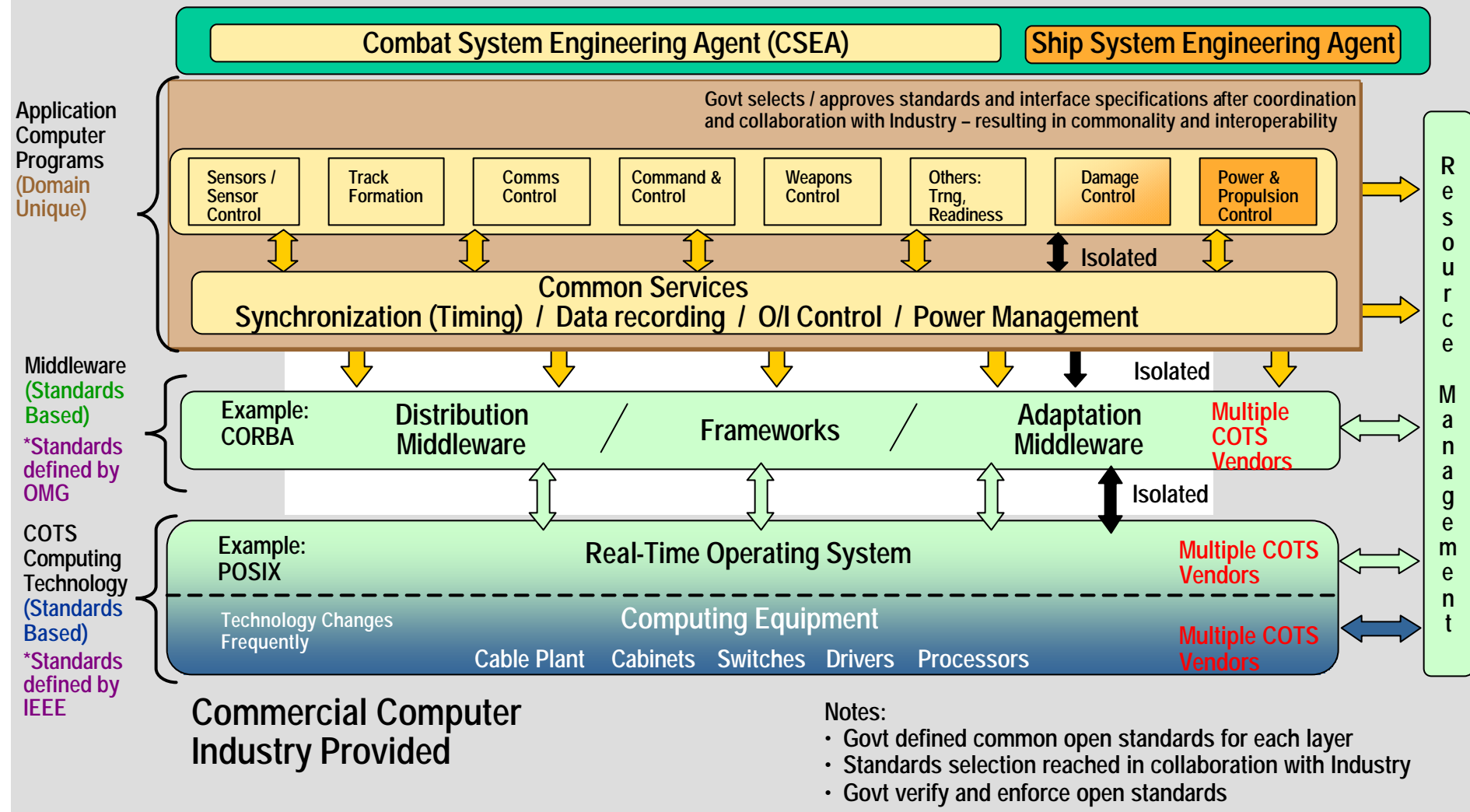
- ◆ A Technical Architecture... Mainstream Standards Based OA **Computing Environment** (OACE)
 - Middleware
 - Operating Systems
 - Computing Equipment
- ◆ A **Functional Architecture**... Technical Reference Model that Identifies Software Domains and Interface Relationships
 - Warfighting Applications
 - Common Service Applications
- ◆ **Engineering and Design Standards**

Key Open Computing System Characteristics

- ◆ Based on Open, Publicly Available Specifications
- ◆ Well-defined, Widely Used Non-proprietary (Standard) Interfaces
- ◆ Durable Component Interfaces
- ◆ Upgradeable

Foundation for 21st Century Combat System Designs

OA Technical Architecture

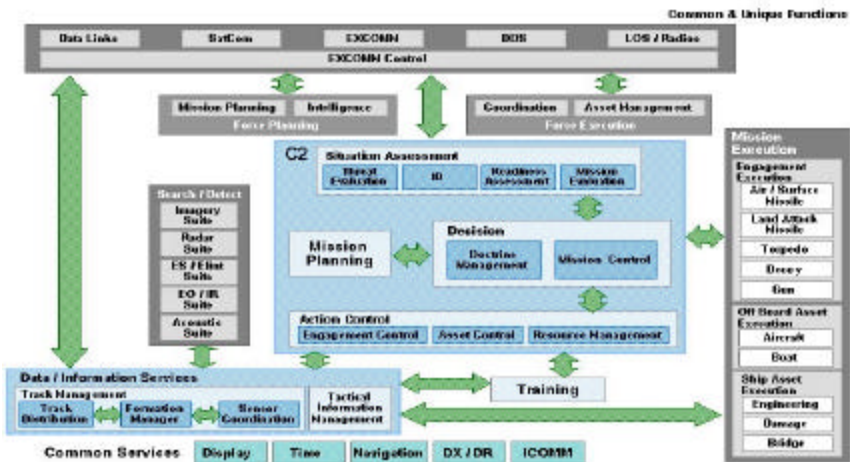


STANDARDS and MIDDLEWARE Isolate Applications From Technology Change

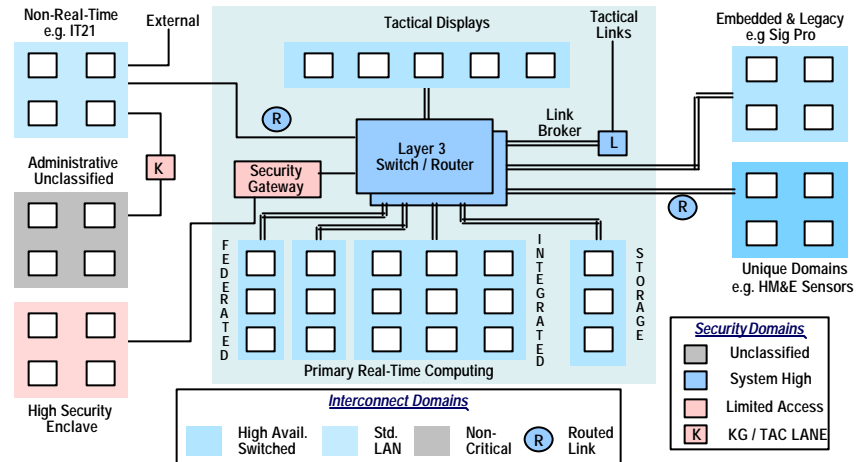
OA System Architecture Views



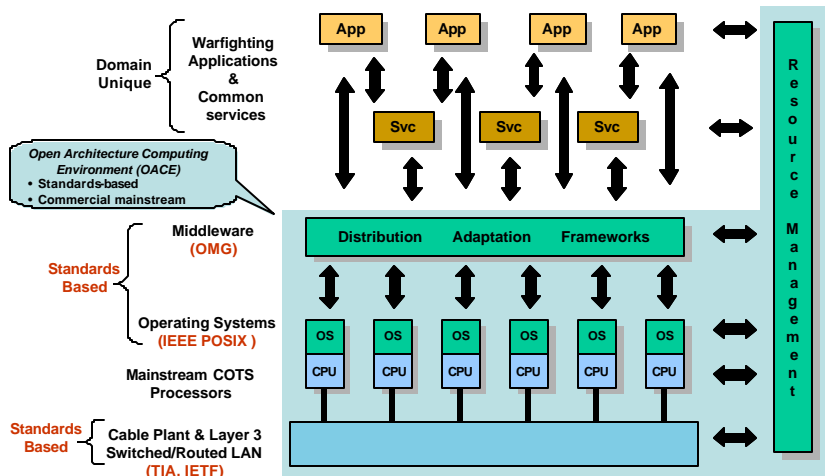
Functional View



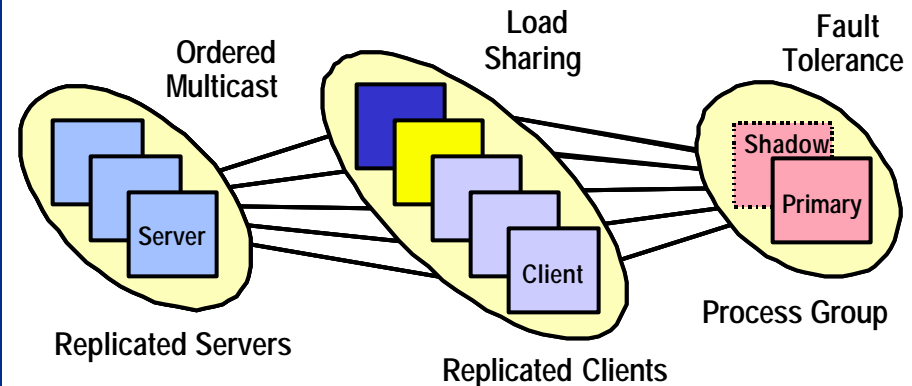
Network & Computer View



Operating System & Middleware View

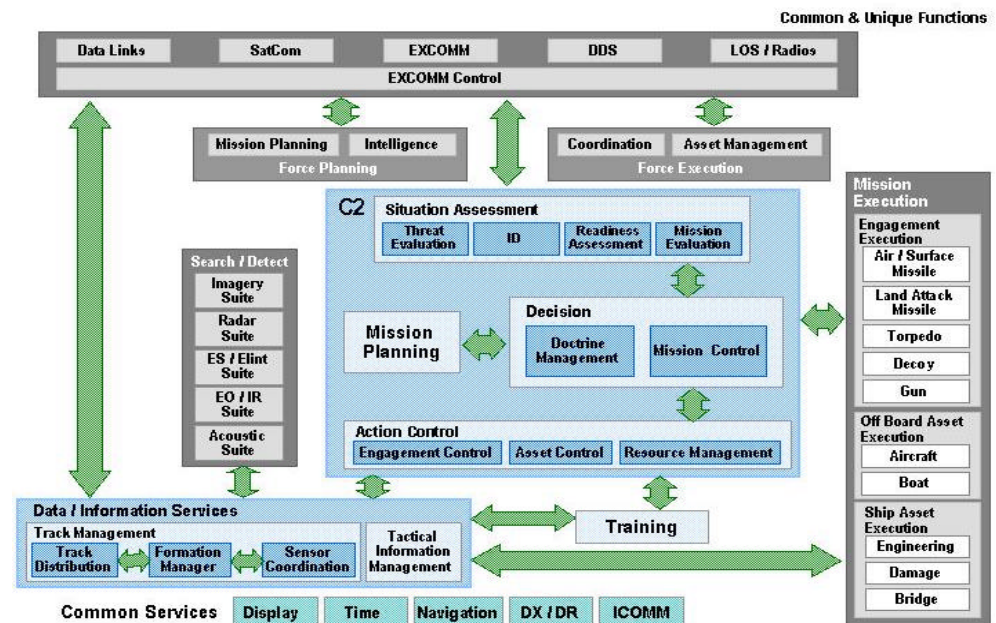


Computer Program View



OA Functional Architecture

- ◆ Translates System Requirements to Functional Requirements and Allocates Functions to Logical Groupings
- ◆ Provides Basis for Identifying Common Service Applications and Common and Unique Warfighting Applications
- ◆ Provides Standardization of Common Components (e.g. C2, ID, etc) and Critical Interfaces Across Systems
- ◆ Provides Standardization of Design Patterns and Data Models

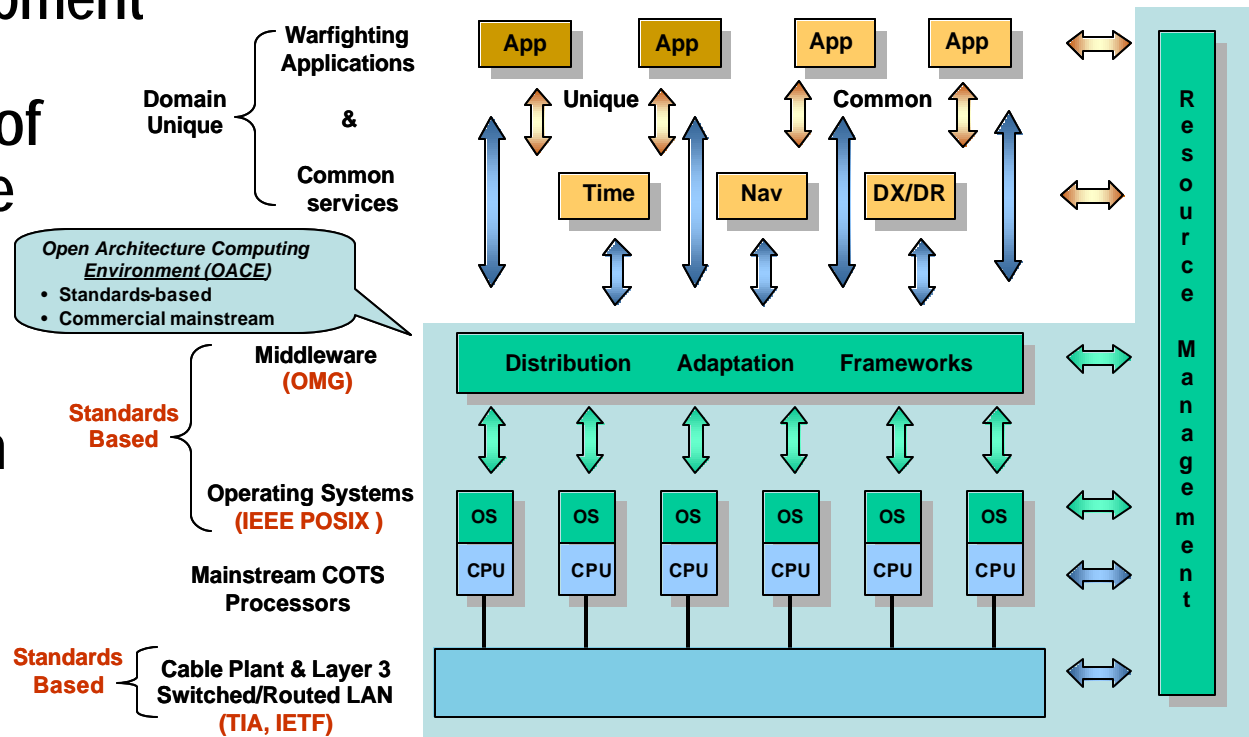


*Essential Enabler For Application Re-Use
Across Platforms*

OA Technical Architecture

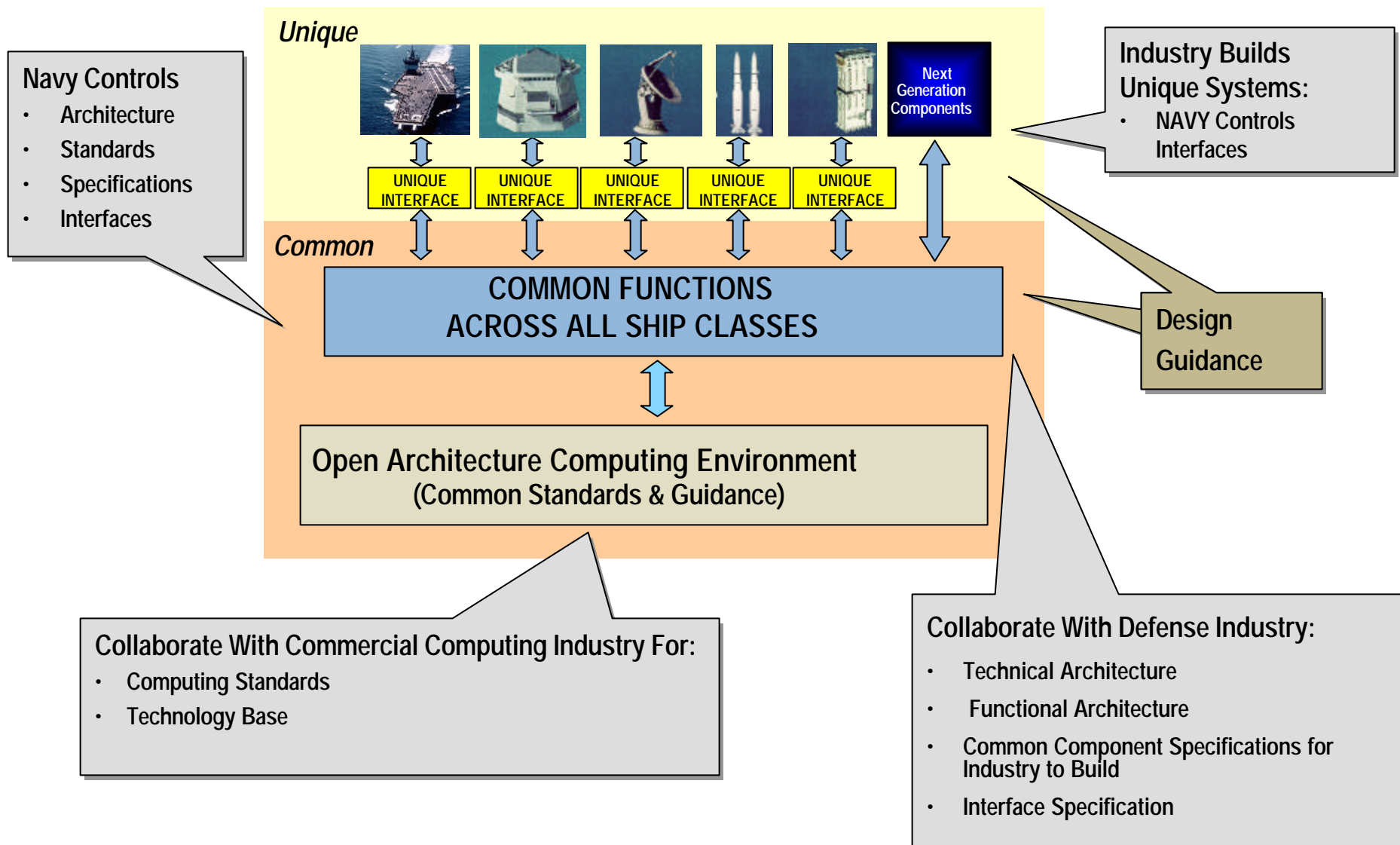


- ◆ Standards Based Computing Environment
- ◆ Includes Middleware, Operating System, Resource Management and Computing Equipment
- ◆ Enables Decoupling of Software to Hardware
- ◆ Enables Affordable COTS Refresh and Technology Insertion
- ◆ Utilizes Commercial Mainstream Computing Products



STANDARDS and MIDDLEWARE Isolate Applications From Technology Change

OA Platform and Process Concepts



OA Strategy



***Current Ships
(Back Fit)***

***Total Ship
Computing
Environment***

All Combat Systems

All Weapon Systems

All C4I Systems

***Future Ships
(e.g. DD(X), LCS, CVN 21, LHA(R) etc.)***

***Net-Centric Concepts
(e.g. FORCEnet, SIAP, etc.)***

OA Implementation Strategy



- ◆ Freeze Computer Program Upgrades That Provide Only Marginal Warfighting Capability Enhancement
- ◆ Complete and Gain Consensus on OA Technical and Functional Architectures Scaleable for Navy-wide Applications
- ◆ Establish and Implement a Rapid Technology Insertion Program Process to Transition Promising Technologies to Certified Warfighting Products
- ◆ Mandate All New Systems Must Comply With OA Standards Specifications and Guidance
- ◆ Pursue Coordination and Agreements With Other Programs

OA Standards and Guidance



OPEN ARCHITECTURE COMPUTING ENVIRONMENT TECHNOLOGIES AND STANDARDS

Version 1.0 (Interim)

March 2003

OPEN ARCHITECTURE COMPUTING ENVIRONMENT DESIGN GUIDANCE

Version 1.0 (Interim)

10 March 2003

DRAFT

RAPIDS RAPID APPLICATION INTEGRATION AND DEVELOPMENT STANDARDS



PEO C4I and Space
24 Feb 2002

DRAFT
V1.5

Subj: OPEN ARCHITECTURE COMPUTING ENVIRONMENT DESIGN GUIDANCE (VERSION 1.0) AND OPEN ARCHITECTURE COMPUTING ENVIRONMENT TECHNOLOGIES AND STANDARDS (VERSION 1.0)

PEO C4I at edward.wunner@navy.mil, or (619) 524-7595, and all technical comments on RAPIDS to Andrew Cox at andrew.cox@navy.mil

5. Your support is greatly appreciated

Edward Wunner *Barry Hicks* *C. N. Bush* *K. D. Slaght*
D. A. BAUMANN A. B. HICKS C. N. BUSH K. D. SLAGHT

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9000	9000	9000	9000
Ser SPAWAR/150	Ser IWS/084	Ser SEA 06/027	Ser C4I and Space/098
20 Mar 2003	20 Mar 2003	20 Mar 2003	20 Mar 2003

JOINT LETTER

From: Commander, Space and Naval Warfare Systems Command
Program Executive Officer for Integrated Warfare Systems
Deputy Commander for Warfare Systems Engineering
Program Executive Officer, C4I and Space

Subj: OPEN ARCHITECTURE COMPUTING ENVIRONMENT DESIGN GUIDANCE (VERSION 1.0) AND OPEN ARCHITECTURE COMPUTING ENVIRONMENT TECHNOLOGIES AND STANDARDS (VERSION 1.0)

Ref: (a DOD 4120.24M, DSP Policies and Procedures

Encl: (1) Open Architecture Computing Environment Design Guidance (Version 1.0)
(2) Open Architecture Computing Environment Technologies and Standards Version 1.0)
(3) Re-usable Application Integration and Development Standards (Version 1.5)

1. The Assistant Secretary of the Navy for Research, Development and Acquisition (ASN (RDA)) assigned the Program Executive Office for Integrated Warfare Systems (PEO IWS) with responsibility for coordinating the introduction of Open Architecture (OA) into the Navy's combat systems. Computing technology is a key part of the OA effort. Therefore, as part of the OA tasking, and based on significant research and testing, the Naval Surface Warfare Center Dahlgren Division (NSWCDD) developed two supporting documents relevant to computing for OA. The *Open Architecture Computing Environment Design Guidance, Version 1.0 (Interim)* document provides interim guidance concerning design aspects of the standards-based computing environment that is to be used in OA warfighting systems. A companion document, *Open Architecture Computing Environment Technologies and Standards, Version 1.0 (Interim)*, provides an enumeration of the standards and product selection criteria that apply to the OA technology base. Taken

ING ENVIRONMENT DESIGN GUIDANCE
ARCHITECTURE COMPUTING ENVIRONMENT
S (VERSION 1.0)

Describe the technical characteristics of systems in support of OA-based set of computing resources is called Environment (OACE). These insight into OACE capabilities and yet fully mature. Accordingly, they view across the naval community for an eding with the formal procedure

utive Office for Command, Control, intelligence and Space (PEO C4I and guidance for all applications within Application Integration and provides detailed programming s to a highly modular design that extension of functional capabilities multiple enterprise architectural des specifications for delivery of elopment Web Environment (DOWE) to s and initiation of a limited open The PEO C4I design documentation s being disseminated for review.

and SPAWAR have made preliminary nts, and believe that they are design documents will serve as the ance across the combat system and ention of PEOs IWS and C4I, along erge these documents where practical remote commonality of implementation

quisite schedule for programs r concurrence and/or comments on requested by 15 May 2003. Please ley comments on OACE to CAPT Thomas treit@navsea.navy.mil or (202) 781- ments to Mr. Michael W. Masters, ture Integrated Product Team (ITA IPT at Masters@navsea.navy.mil. Please

direct all programmatic and policy comments on RAPIDS to Ed Wunner,

OACE Migration Levels



<u>Level 1</u> Hardware Adapter	<u>Level 2</u> Adaptation Layer	<u>Level 3</u> Port to OACE	<u>Level 4</u> OACE-Based & Redesigned	<u>Level 5</u> OACE-Based & Integrated
<ul style="list-style-type: none"> ◆ Old App. ◆ Old H/W ◆ Old OS, M/W Interfaces, etc. ◆ Physical I/F Adapter <div> <div>Non-OACE Application</div> <div>Non-OACE Environment</div> <div>Hardware Adapter</div> <div>OACE-Based Applications</div> </div>	<ul style="list-style-type: none"> ◆ Old App. ◆ Old M/W I/F ◆ OACE H/W & OS ◆ Adaptation Layer is "Wrapper" <div> <div>Non-OACE Application</div> <div>Adaptation Layer</div> <div>OACE</div> </div>	<ul style="list-style-type: none"> ◆ App. Ported to OACE OS & Middleware ◆ OACE H/W ◆ No Change to Application Architecture ◆ Optionally, OA Services used e.g. Time, Nav, DX/DR, etc. <div> <div>OACE-Based Application</div> <div>OA Services</div> <div>OACE</div> </div>	<ul style="list-style-type: none"> ◆ App. Runs on OACE H/W, OS, Middleware, ... ◆ Application Redesigned to Use OA Arch. Patterns, e.g. Fault tol., Scalability ◆ App. uses OA Common Services & Functions <div> <div>OACE-Based Application</div> <div>OA Functions</div> <div>OACE</div> </div>	<ul style="list-style-type: none"> ◆ App. Runs on OACE H / W, OS, Middleware, ... ◆ Apps are Location Transparent & Share Resources ◆ Apps Instrumented for Dynamic QoS * <div> <div>Dynamic Resource Management</div> <div>OACE-Based Application</div> <div>OA Functions</div> <div>OACE</div> </div>

** Applications at any Level may be Started and Stopped Under DRM but Cannot be Fully Qos Managed Unless Instrumented*

CG / DDG OA Introduction

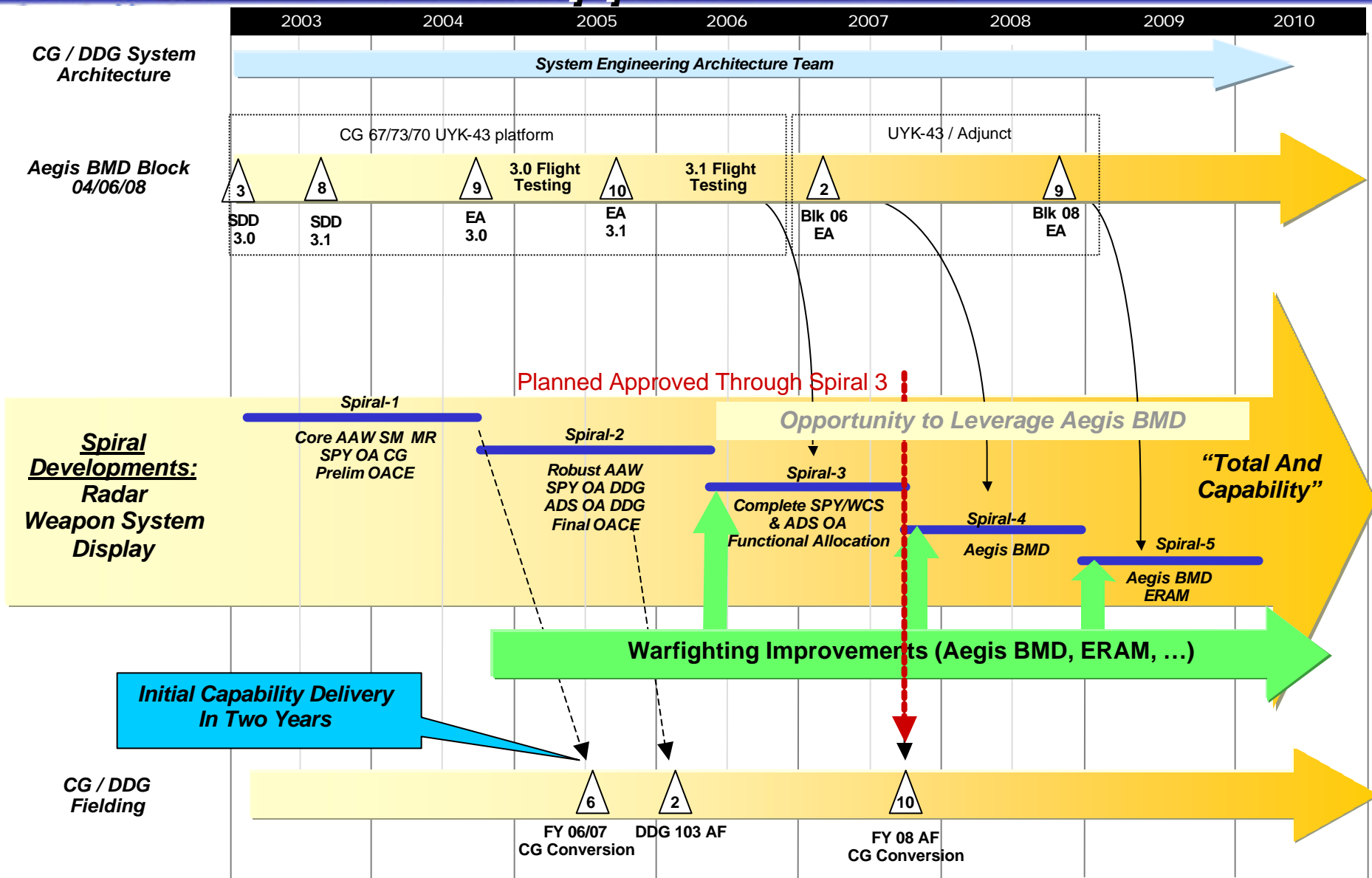


- ◆ OA Introduction into AEGIS Fleet will Result in:
 - Certified SPY B / D in FY06 in 1st CG Conversion and Follow-on
 - Certified SPY D(V) and ADS OA in FY06 DDGs (D(V) Post Delivery ECP)
 - Certified SPY B / D, WCS and ADS in FY08 CG Conversion
- ◆ At-Sea Test and Land Based Demos in CY04
 - SPY OA Spiral 1 At-sea Test (Includes SPY OACE Host, Faster Boot Time, Message Passing S / W Architecture, ADIP / TCA)
 - WCS and ADS Spiral 1 Land Based Demos (Includes ADS Framework, WCS SM-2 MR)

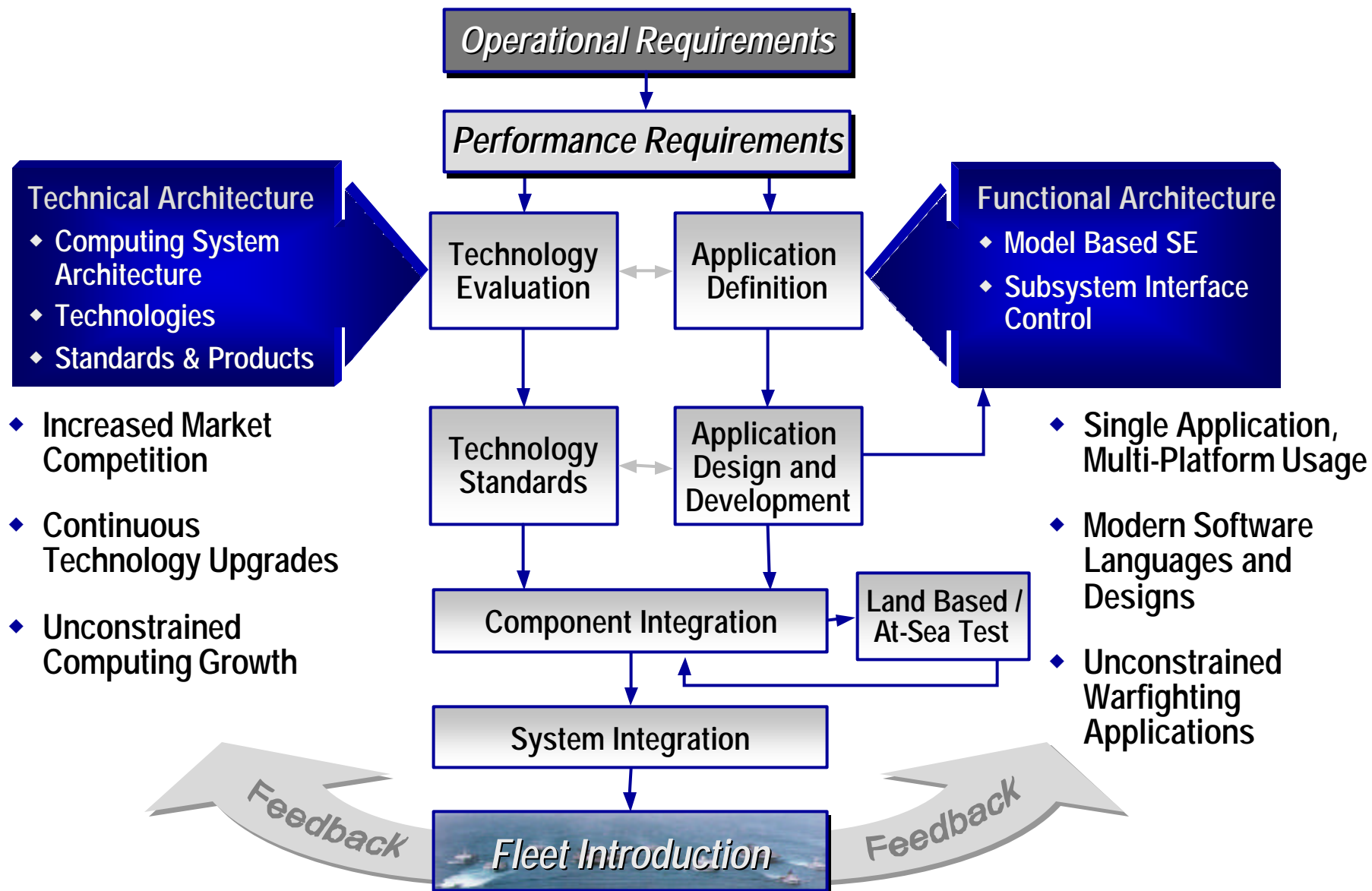
SPY, WCS and ADS OA Compliant in 08

CG / DDG OA Spiral Development Schedule

... 3/19 Approved Plan



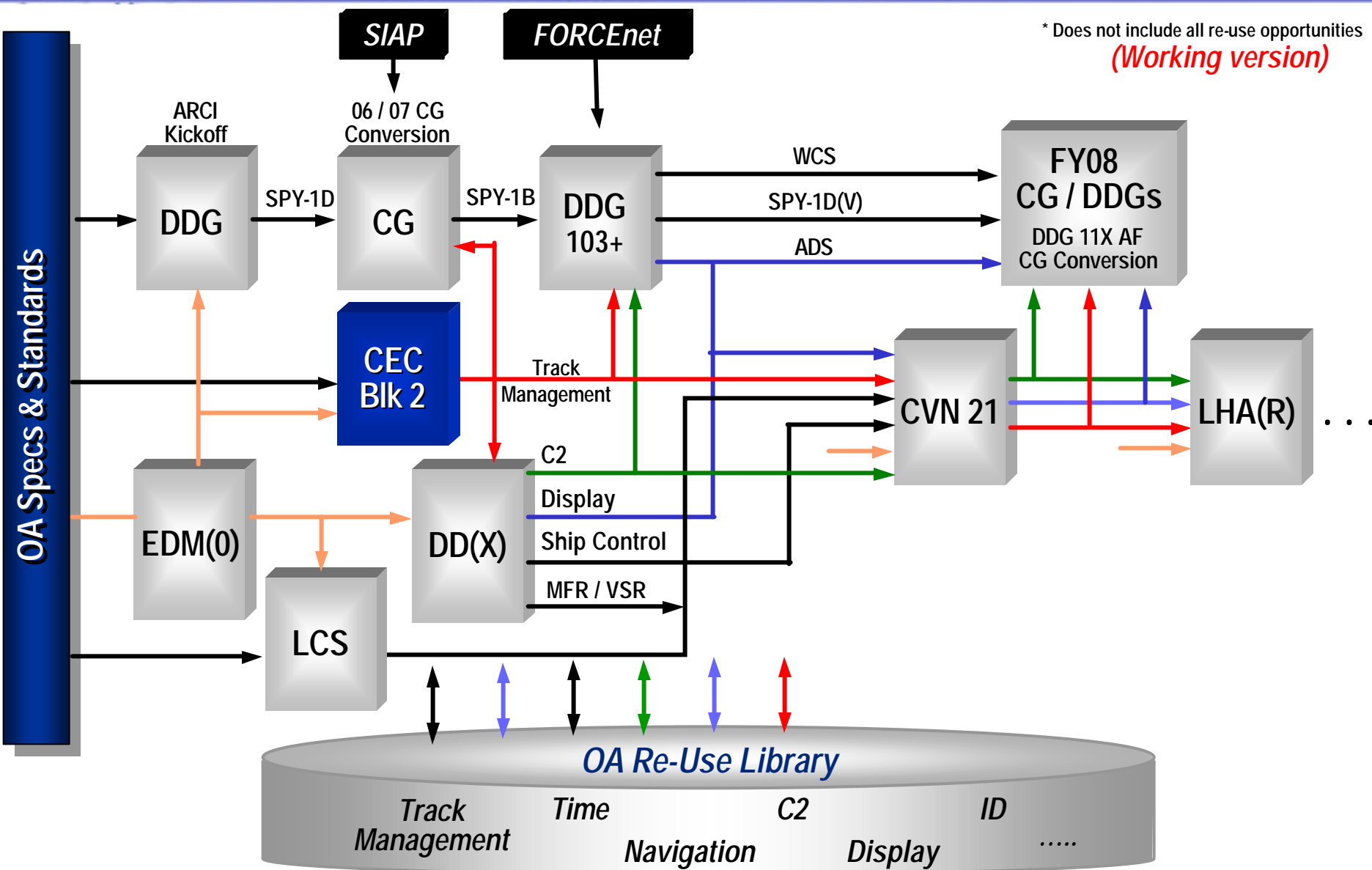
OA RTIP Process



OA Roadmap for IWS Programs



* Does not include all re-use opportunities
(Working version)



Big Navy Organizational Relationships





- ◆ PEO Integrated Warfare
- ◆ PEO Littoral and Mine Warfare
- ◆ PEO Ships
- ◆ PEO Submarines
- ◆ PEO Aircraft Carriers



SPAWAR

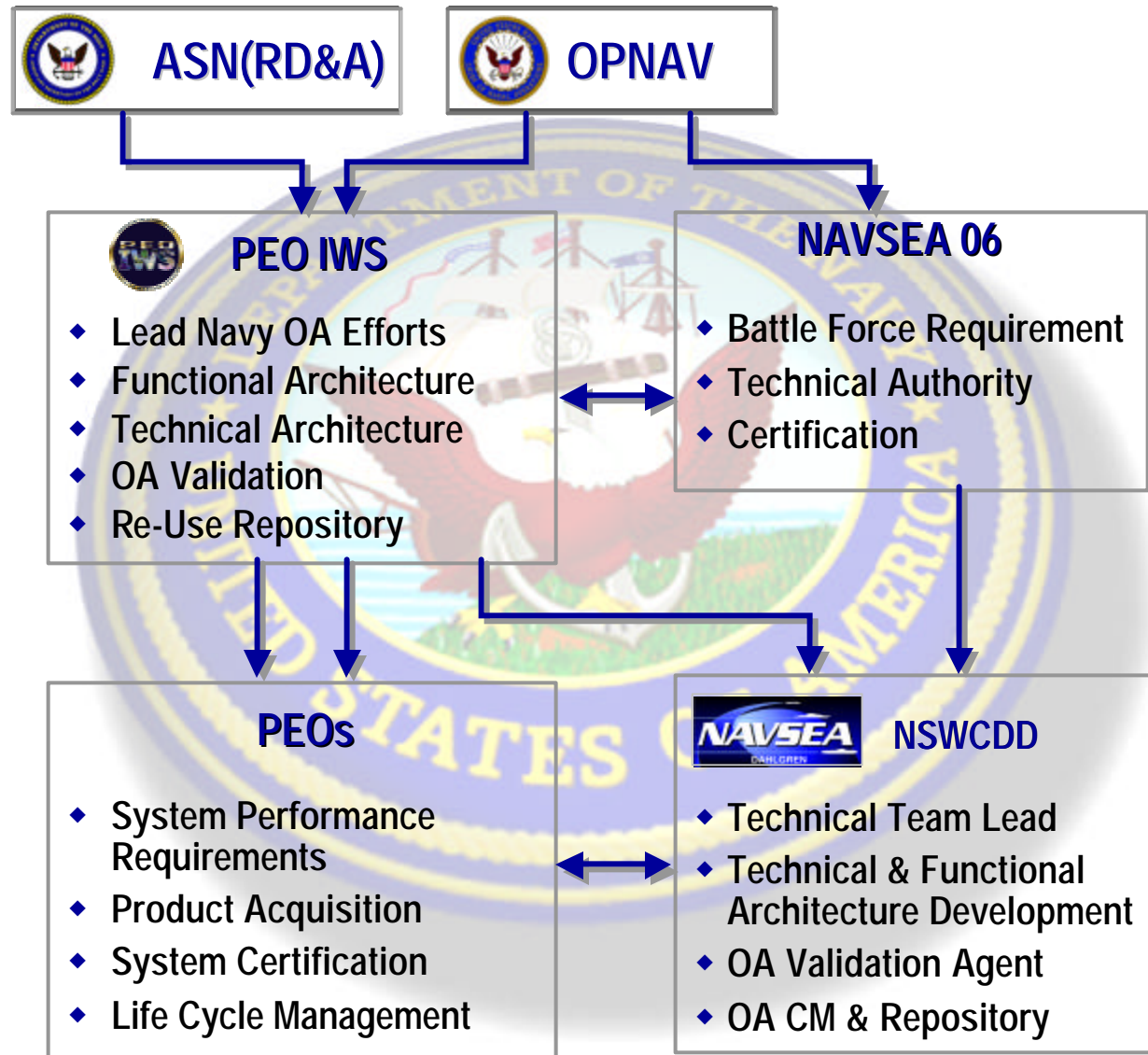
- ◆ PEO Information Technology
- ◆ PEO C4I and Space



- ◆ PEO Tactical Air Programs
- ◆ PEO Air ASW, Assault and Special Mission Programs
- ◆ PEO Strike Weapons and Unmanned Aviation



MARCOR

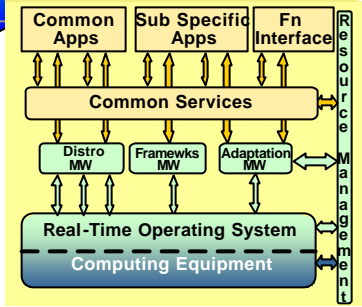
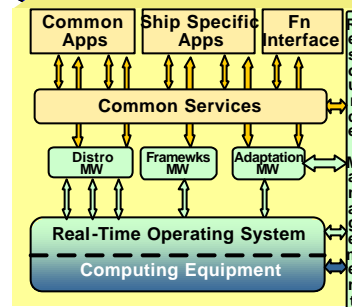
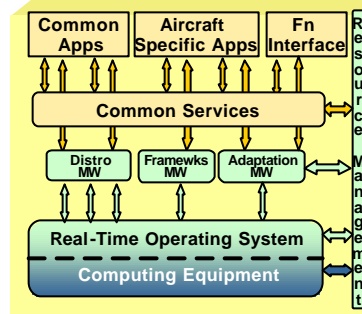


Open Architecture and FORCEnet



- ◆ Network Centric Warfare Warfighting Enabler
- ◆ FORCEnet is the Architectural Framework
- ◆ Open Architecture (OA) is the Computational Underpinning

Open Architectures Required to Realize FORCEnet in Both Cost and Performance



Joint Binding Standards / Protocols Ensure Interoperability

Steps Already Taken



Policy

- ✓ Froze AEGIS and SSDS Future Upgrades to Sponsor Approved Requirements Only
- ✓ Rewrote CEC Blk II RFP to Include Requirement for an OA-Based Solution
- ✓ Released Interim Documents That Provide OA Specifications, Standards and Design Guidance
- ✓ Signed Cooperative MOAs With SPAWAR, SIAP and Ships
- ✓ Promulgated OA Contract Policy for All New Acquisition

Programmatic

- ✓ Stopped AEGIS B/L7p2 – AEGIS OA – Solution Too Narrowly Focused
- ✓ Redirected DD(X) From Vendor-WCK TSCE Solution
- ✓ Established OA Rapid Technology Insertion Program (“ARCI-like”)
- ✓ Realigning Budgets to Support OA in PR05 and POM 06

Organizational Alignment

- ✓ Established PEO IWS OA Directorate
- ✓ Established OA Organization With Big Navy Involvement (ASN(RDA), OPNAV, SEA 06, Other PEOs, Field Activities)
- ✓ Significant Interaction With Fleet, Type Commanders, Systems Commands, Industry and Field Activities

Technical Alignment

- ✓ Discussions With OPNAV N61 Regarding Alignment of OA With FORCEnet
- ✓ NAVSEA 06 Assigned OA Technical Authority
- ✓ NSWCCD Designated OA Technical Team Leader
- ✓ Government / Industry Technical IPTs

Summary



- ◆ **Today's Fleet Computing Architectures are Performance Limited and Expensive to Upgrade**
- ◆ **Implementation of Warfighting Functions Using Standard Based Solutions Will Enable Common, Interoperable Capabilities to be Fielded Faster at Reduced Cost**
- ◆ **Rapid Technology Insertion Program (RTIP) Will Provide Structural Approach for Introduction of OA Components into the Fleet**